

Water management in Ontario

Ontario
Water Resources
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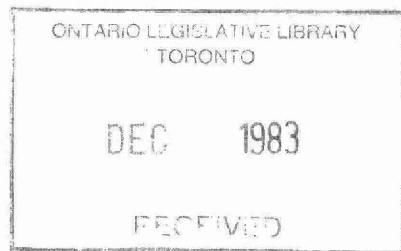
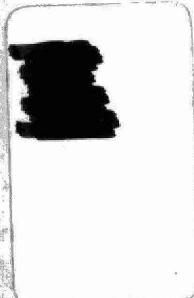
DEICING SALT

AS A

SOURCE

OF

WATER POLLUTION



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ONTARIO WATER RESOURCES COMMISSION
WATER QUALITY SURVEYS BRANCH

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INTRODUCTION

Chloride levels in the Lower Great Lakes have shown a gradual increase since the turn of the century. Industrial and municipal waste inputs have, no doubt, been largely responsible for this rise; however, the increasing use of salt as a deicing agent has, in the past few years, raised many questions as to the effect of chlorides from this source on water quality.

The objectives of this report are to illustrate the effects of road salting operations on chloride levels in water-courses flowing through Metropolitan Toronto; to assess the magnitude of chloride inputs to Lake Ontario directly attributable to road salting; and, to compare this input to other major contributors of chlorides to the lake.

DEICING SALT

Sodium chloride (rock salt), the most commonly used deicing agent, is composed of 94 to 97 percent pure sodium chloride plus small quantities of chlorides, carbonates and sulphates of calcium and magnesium. Rock salt is an effective deicing agent to a temperature of about -6 degrees Fahrenheit. Prussian Blue (ferric ferrocyanide) is a commonly used rock salt additive that helps prevent caking and inhibits corrosion. Ferric ferrocyanide is insoluble in water and does not release cyanide upon acidification. In 1959 an experiment designed to determine the toxicity of ferric ferrocyanide was carried out. A commercial grade deicer containing ferric ferrocyanide was added to water to form a concentration of 9600 mg/l of salt. Blunt-nosed minnows did not appear to be affected at this concentration during a 48-hour test period. (U.S. Highway Research Board). Prussian Blue is a commonly used bluing agent in laundry products.

CHLORIDE INPUTS TO LAKE ONTARIO FROM METROPOLITAN TORONTO

Toronto was chosen for the study because large quantities of rock salt are applied each winter to the roads in the Metro Toronto area and relatively complete salting records are maintained. Water quality data were available from OWRC records.

Road salting records for the winter periods 1966-67 through 1969-70 are presented in Table I.

Data on chloride levels for each of the five streams (Etobicoke Creek, Mimico Creek, Humber River, Don River and Highland Creek) within Metro Toronto are shown in Table II.

Seasonal increases in chloride concentrations as high as 330 percent were measured in the Don River where levels rose from a baseline level of 105 mg/l to 452 mg/l during the winter of 1968-69. Similar increases were noted in each of the streams under study throughout the 1966-70 study period.

SIGNIFICANCE OF CHLORIDES FROM DEICING SALTS

In order that chloride inputs from road salting operations could be related to the total chloride input to Lake Ontario as contained in the report to the International Joint Commission on the Pollution of Lake Erie, Lake Ontario and the International Section of the St. Lawrence River (1969); road salting, sewage treatment plant effluent and water quality records for the years 1966-67 were employed.

For the 1966-67 water year (October-September) a total of 61,000 tons of chlorides reached Lake Ontario from the five streams draining the Toronto area.

The chloride contribution from the three directly discharging sewage treatment plants (Humber, Long Branch and Main) * was calculated to be about 50,000 tons.

* The Highland Creek STP is considered to discharge to Highland Creek and chloride loadings from this plant are included in the Highland Creek loading figures.

TABLE I
 Salt Applied by All Sources in
 Metro Toronto
 1966 - 1970

District	1966-67	Tons Applied/Year		
		1967-68	1968-69	1969-70
Metro Toronto	54,000	76,491	57,521	78,000
City of Toronto	32,548	25,921	20,576	33,262
Etobicoke	10,000	11,200	12,500	12,500
East York	2,900	2,900	2,155	2,736
North York	20,039	20,034	16,636	26,500
York	2,000	2,502	2,132	2,700
Scarborough	18,645	21,737	17,400	24,580
D.H.O. Toronto	15,668	21,650	19,950	33,000
Total	155,800	182,500	148,900	215,200
Tons Chloride	93,000	109,500	89,400	129,200

TABLE II

Chloride Concentrations in Five
Metro Toronto River Basins

Water Year	Stream	Baseline*	Winter*
1966-67	Etobicoke	116	223
(Oct.-Sept.)	Mimico	120	546
25 samples/station**	Humber	55	135
	Don	115	343
	Highland	130	221

1967-68	Etobicoke	112	160
	Mimico	117	247
25 samples/station	Humber	51	117
	Don	120	452
	Highland	172	205

1968-69	Etobicoke	101	161
	Mimico	94	315
27 samples/station	Humber	52	198
	Don	105	452
	Highland	131	296

1969-70	Etobicoke	117	273
	Mimico	106	439
18 samples/station	Humber	70	199
	Don	130	480
	Highland	130	345

*All concentrations expressed in mg/l.

**Each stream was sampled near its mouth at approx.bi-weekly intervals.

The measured sources (sewage treatment plants and streams) contributed a total of 111,000 tons of chlorides per year. In addition, there are some 19 directly discharging storm sewers, which undoubtedly carry much of the remaining salt applied to Metropolitan Toronto roads to Lake Ontario. If it were assumed, taking the extreme case, that all the chlorides applied (93,000 tons) reach Lake Ontario, the total input of chlorides from the Toronto area would be about 184,000 tons of which 50% would be the direct result of road salting.

From the IJC report the total chloride input to Lake Ontario, excluding the Niagara River, amounted to 1,670,000 tons per year. For direct discharges to the Lake, this breaks down to approximately 150,000 tons from municipal treatment plants, 10,000 from industries and 1,510,000 tons from river basins. Industrial discharges in the Oswego River in New York State are the largest contributors of chlorides in the Lake Ontario Basin. This river alone discharges over 1,000,000 tons per year of chlorides or 60 percent of the total input to the Lake.

In order to establish a total chloride loading to Lake Ontario from road salting operations in Ontario and New York State, an estimation of salt application was made using population and available Ontario salting records. It was assumed that salt application in New York State was similar to Ontario's rates and methods. It is recognized that, with the larger snowfalls generally occurring along the south shore of Lake Ontario, the estimate of salt applied in New York State could be a conservative figure.

On the basis of similar application rates, the input of chlorides attributed to road salting operations from the major municipalities and highways around Lake Ontario totalled about 300,000 tons in the 1966-67 winter period. (Ontario - 180,000 tons, New York - 120,000 tons).

Using the total chloride loading to Lake Ontario of 1,670,000 tons (IJC) and assuming that most of the chlorides applied as deicing salt reach the Lake, road salting represents slightly less than 20 percent of the total chloride input. If, however, the large industrial input to the Oswego River (Allied Chemical Corporation, Solvey Process Division - 1,130,000 tons per year (FWQA) were substantially reduced, chlorides from road salting operations would exceed 40% of the total input.

DISCUSSION

Chloride inputs from road salting operations, while not the largest single source, do contribute significantly to chloride concentrations in Lake Ontario and with the continuing urban development around the Lake, loadings from road salting will increase.

The chloride concentration in Lake Ontario averages between 25 and 30 mg/l and while this level appears to be low when compared to the OWRC permissible criterion for public surface water supply of 250 mg/l, it exceeds the desirable water supply criterion of "less than 25 mg/l" and the desirable criterion for tobacco crop irrigation of "less than 20 mg/l". Chloride criteria for industrial and other uses are generally higher than those mentioned above and are presented in the OWRC "Guidelines and Criteria for Water Quality Management in Ontario".

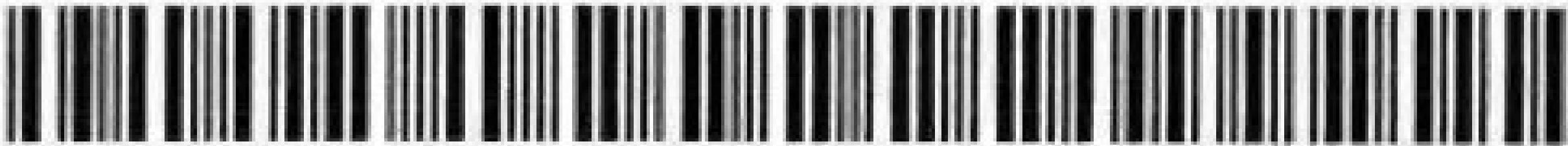
Probably of more significance than the overall effects of road salting on the chloride levels in Lake Ontario is the seasonal increase found in watercourses adjacent to major urban areas. In the Don River, for example, the summer chloride levels are acceptable for most uses, but during the winter months levels exceed the permissible criteria for all water uses. While the Don River and other streams flowing through Metropolitan Toronto are not presently used for purposes which require low chloride concentrations, similar increases could occur in river basins or harbour areas where water is drawn for domestic or industrial supply or other uses which are sensitive to high chloride concentrations.

Sufficient data are not available to calculate the seasonal chloride fluctuations in areas of the Lake adjacent to major sources; however, average chloride concentrations in the Toronto and Hamilton harbours are 50 to 100 percent higher than the average levels in the Lake and it is likely that much higher levels would be measured in these areas during the winter months.

In conclusion, the use of deicing salt is an essential operation in Canada and the Northern section of the United States and, until a satisfactory substitute for salt has been found, every practical effort should be made to eliminate the unnecessary loss of salt through such means as salt storage bins and reduced application rates.

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